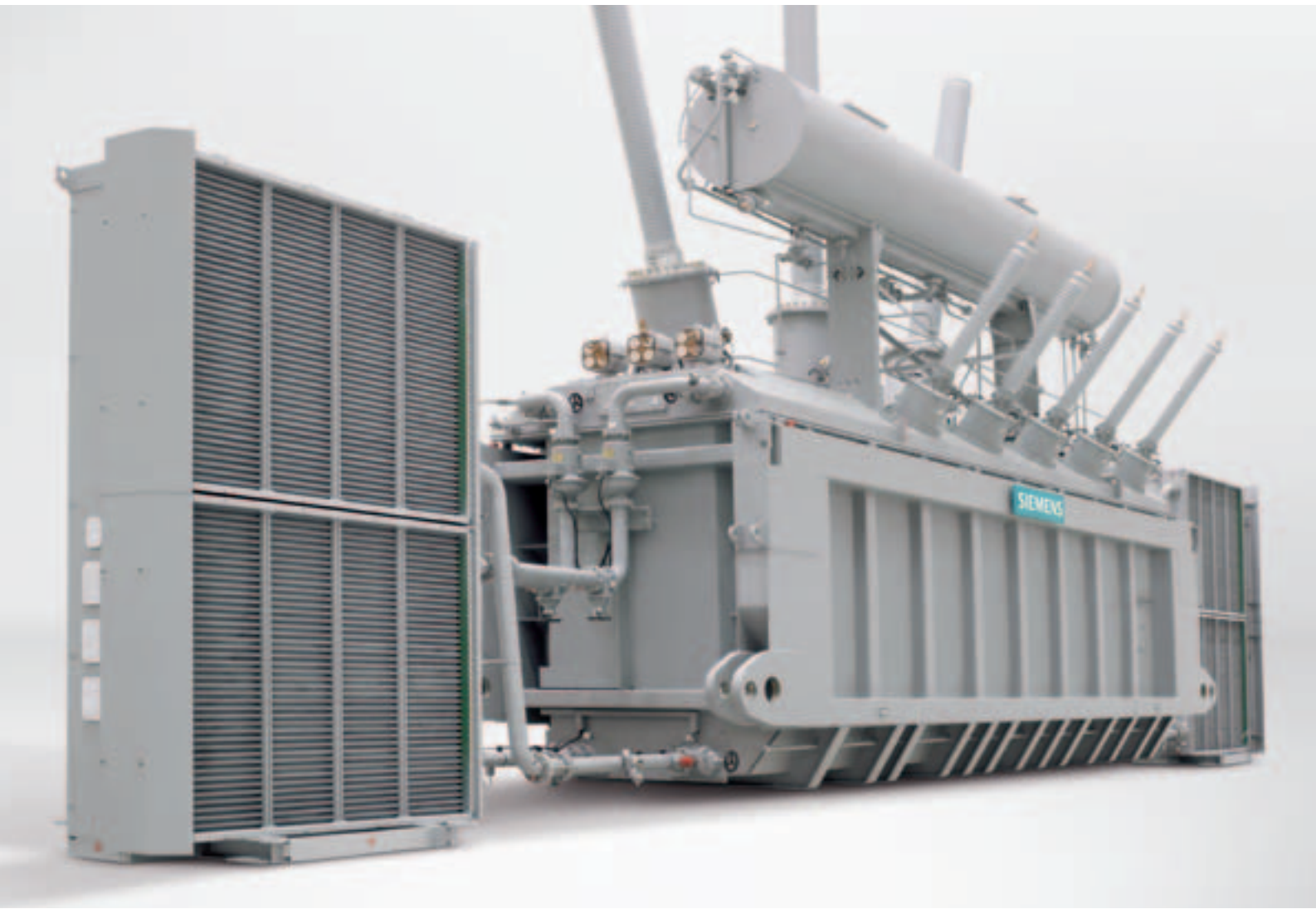
Transforming pure power into stable supply. Siemens Transformers.

Power transformers above 200 MVA

Power Transmission and Distribution

SIEMENS

Transforming application into performance



Bringing the energy safely to the consumer: A basic requirement applicable to all power transformers. However, every single one is unique – designed according to individual factors such as voltage, power, climate, system topography, sound level and many more. Siemens is your partner, who picks up these requirements converting them into convincing solutions with maximum quality. Power transformers that render their service reliably at site. Cost-efficient and safe throughout decades.

Many reasons for reliability

First of all, there is the fulfillment of the quality claim to which we have committed ourselves without compromises. Every factory manufacturing Siemens Transformers puts our quality management system according to DIN ISO 9001:2000 into practice. And only those transformers that have successfully passed all the comprehensive tests will then go into practical application.

Siemens offers a complete service – from advice and design via manufacture, transport and commissioning up to our Transformer Life Management.

100 years of experience – 100 % passion for your task

For more than one century, power supply and industrial companies have relied on Siemens Transformers. Magnitude and closeness – cooperating with Siemens you will benefit from both aspects. As one of the leading transformer manufacturers worldwide we offer a tight network of competence, being, at the same time, your contact partner who implements your requirements – in more than 190 countries in the world.

Fit for big duties: 200 MVA and more

In the power range above 200 MVA, generator and network interconnecting transformers are requested above all – with on-load and off-load tap-changers, or a combination of both.

Siemens Transformers can be conceived for each and every requirement: As multi-winding transformers or autotransformers, in three-phase or single-phase versions. Even with ratings of more than 1000 MVA and voltages up to 765 kV (800 kV), the limits of possibility are not yet reached. We are manufacturing such units according to IEC 60076 as well as other international and national standards (e.g. ANSI/IEEE).

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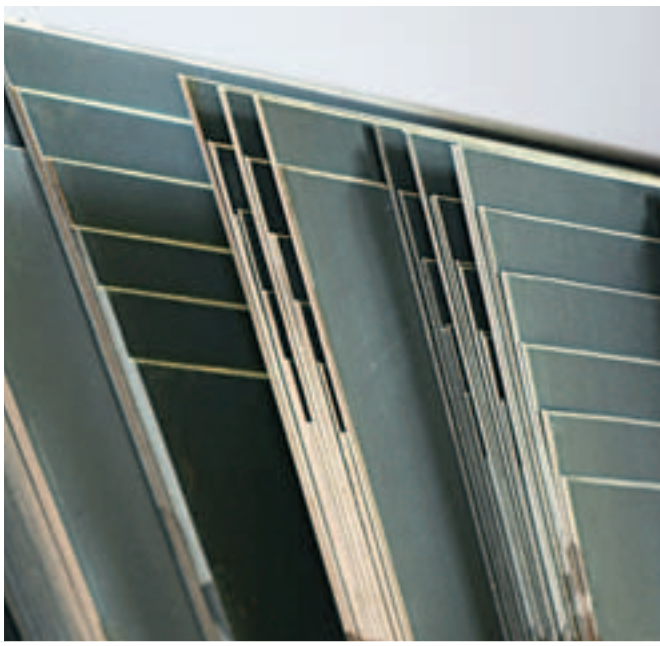
A filigree heavyweight is produced: the iron core



The precision of core manufacture is a decisive factor for the later efficiency of the transformer. Siemens Power Transformers are produced as core types, with the wound and unwound limbs of the core arranged at the same level and interconnected via yokes.

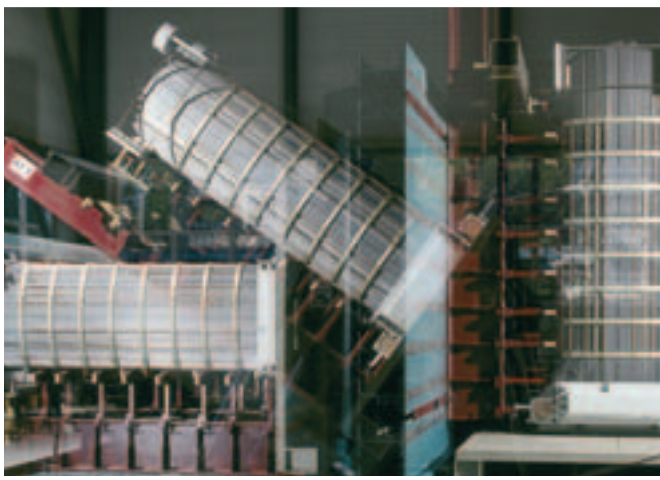
We regard the recognized high quality of this component literally as our "core competence". This course is set by using high-grade cold-rolled laminates – with a thickness of 0.3 mm and less. Depending on the requirement, laser-treated laminates are also used.

When these laminates are cut, we rely on most modern numerical control systems enabling the so-called step-lap cutting – with the consequence of an especially appropriate flow characteristic at the joints. On the other hand, this is the basis for low losses and the minimization of no-load noises.

Precision work – layer by layer

First step – cutting the laminate: The core laminates supplied as coils are first divided longitudinally without burrs, and then cut to their final shape. Computer control provides for safe compliance with minimum tolerances.

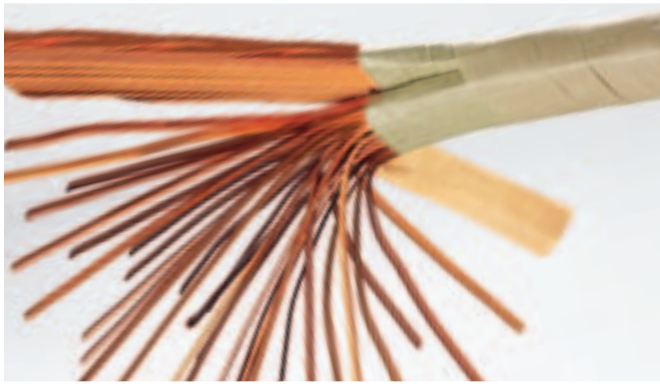
Second step – core laying by most modern appliances: Designed for transformer cores of several hundred tons, the hydraulic table shifts the iron core from the horizontal layer position into the vertical assembly position. For transportation, air-cushion transport pallets are used.



Precision work all around: the windings

High electrical and mechanical stress belongs to the daily life of transformers. Here, the windings are especially concerned. That is why Siemens uses disc windings characterized by a high mechanical stability and thus, convincing operational reliability.

The winding material consists of copper wire. Which type of winding will be used for the specific application depends on the necessary rating and voltage.

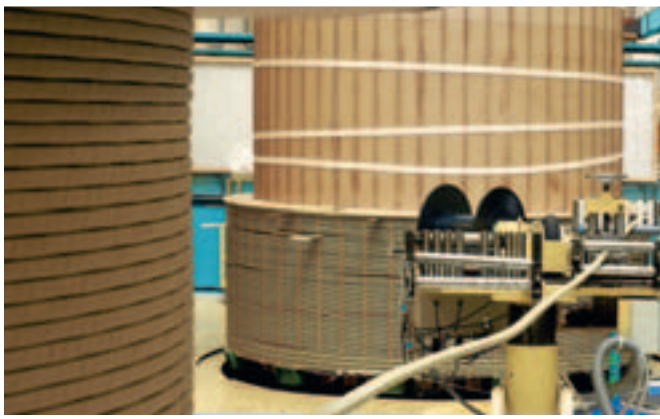


Transposed conductors reduce the additional losses. They consist of a number of transposed profile wires.

For high voltages – windings made of disc coils

Windings made of disc coils are preferred for high voltages. They consist of continuously wound coils divided by radial and axial ducts for oil cooling.

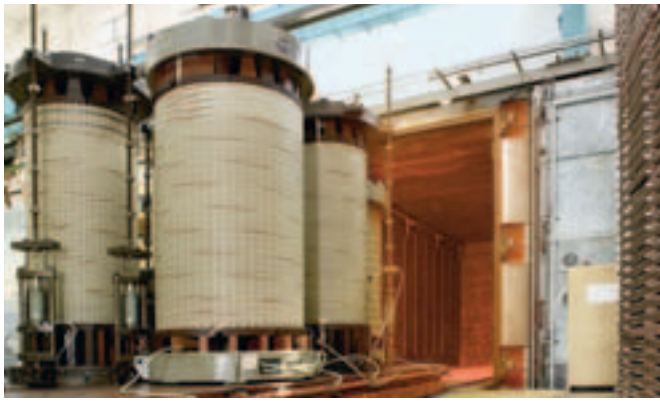
Manufacturing takes place on vertical and horizontal winding banks. Continuous winding of disc coils reduces the soldering points to a minimum. Precise control systems provide for constant pressure and winding pull, while experienced coil winders monitor every operation.



Windings for limit ratings require complicated designs. Our solution: Use of transposed-conductor windings, even for highest voltage ratings.

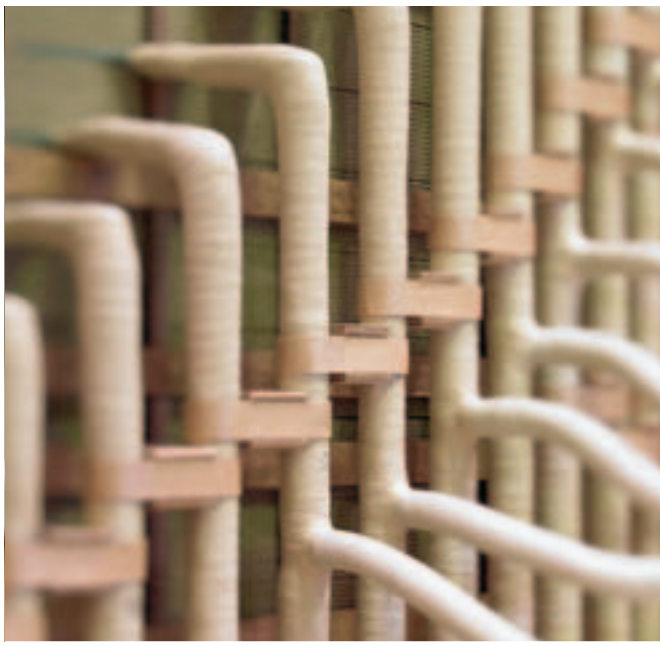
For low voltages – windings made of cylinder coils

For low voltages, the use of layer windings has proven successful. They consist of cylinder coils which are concentrically arranged one above the other and separated via axial oil ducts.



Careful after-treatment plays a decisive role in order to prepare the windings for the high demands of operation. Therefore they are pressed, dried under constant pressure, oil-impregnated, exactly measured and, if required, readjusted geometrically.

Know-how brought to the point: the voltage variation



To adjust the ratio safely and easily to the system conditions, Siemens Power Transformers have a tapped winding. The advantage: In this way, the ratio can be changed gradually – either in no-load condition via off-load tap-changers or under load by means of on-load tap-changers.

While off-load tap-changers are normally adjusted manually, particular motor operating mechanisms are available for on-load tap-changers. They can be controlled locally or from remote.

On-load tap-changer for voltage variation under load:

1

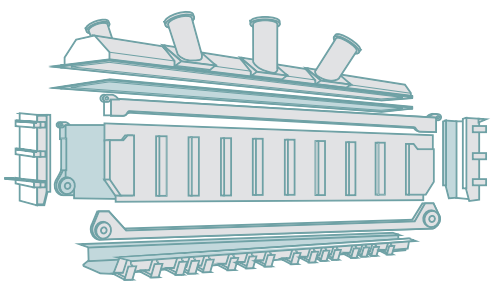
The on-load tap-changer is placed in an oil-filled insulating vessel that separates it reliably from the transformer coolant. At the same time, this prevents the decomposition products generated by arcs from getting into the transformer oil.

2

The selector is operated in no-load condition and is therefore directly surrounded by transformer oil.

The protective cover: the tank

Another main component besides the core and the winding is the tank: It accommodates the active part and the oil filling – often weighing several hundred tons together. No question that this requires a statically safe and oiltight design with an optimized weight. First-class corrosion protection is the basis for the long life of the tank.



The way to the customer:

Dimensions and weights of transformers place high demands on transportation. This tank type manufactured by segments is hinged into a cantilever-type two-bogie car (Schnabel car) as a self-supporting central part.

More than the sum of parts: the final assembly

The core, windings, pressed parts, tap-changer and connecting cables make up the active part of the transformer. Special attention is paid to the mechanical stability of the windings.

Using a common pressure ring for all windings of a limb, the geometric positions of the individual windings can be adhered to exactly. This is important in order to minimize axial thrust forces. The necessary clamping force is adjusted hydraulically with a high precision after drying. The active part is dried according to the vapor-phase procedure.

After that, all bolted joints of the active part are checked and secured. Then, the active part – which still has a temperature of more than 100 °C – is installed in the tank and filled with high-grade insulating oil under vacuum. When the built-on parts – such as motor operating mechanism, switchgear cubicles, bushings or monitoring devices – are finally fitted, the transformer is ready for final testing after having reached the unenergized time.

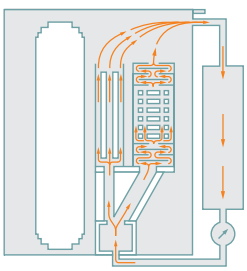
A spectacular moment:

The active part – dried in the vapor-phase facility under vacuum at 130 °C – is moved into the tank.

For a long transformer life: the right cooling

For the operational reliability and service life of the transformer, the effectiveness of the cooling is of decisive importance.

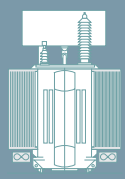
Various cooling methods are applied for transformers above 200 MVA – above all, oil/air cooling ONAN, ONAF, OFAF and ODAF as well as oil/water cooling OFWF and ODWF. The radiator batteries or oil/air and oil/water coolers can be mounted on the transformer or installed separately.



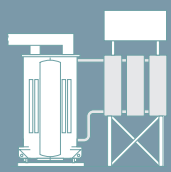
For large transformers, more effective cooling can be achieved by directed oil circulation through the windings.

Cooling methods:

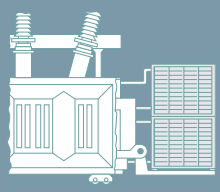
Built-on radiators with and without fans (ONAF / ONAN)



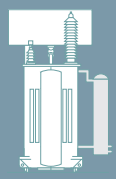
Separate radiator battery (ONAN / ONAF / OFAN / OFAF / ODAN / ODAF)



Built-on air cooling system (OFAF / ODAF)



Built-on oil/water cooler (OFWF / ODWF)



Securing and documenting the quality: the final test

Every transformer we deliver must run through a series of strict final tests in Siemens-owned testing laboratories. The scope of testing reaches from routine tests with dielectric tests – including lightning impulse withstand voltages – via temperature-rise tests up to a wide range of special tests, whether insulation resistance, harmonics or sound level. Tests concerning the short-circuit strength are performed at internationally accepted and approved institutes.

In other words – you can rely on tested quality. Power transformers from Siemens range among the most reliable in the world.

Our quality assurance system accompanies the transformer from the order to handing over – and, if requested, throughout its entire service life. An important stop is e.g. the extra-high-voltage testing station.

Siemens Power Transformers: in operation all over the planet

Power transformers are needed to supply energy to more and more people and growing economies.

Siemens is a worldwide partner for power supply and industrial companies – accordingly, the examples of our work are global: Whether in South America, Asia or Europe, whether in the desert or in specially demanding applications 15 meters underground. Ten thousands of plants run efficiently and reliably with our technology.

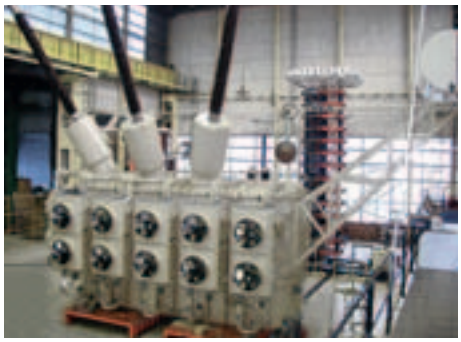
When will we have the opportunity to present your project here?

Hydro power for China

15 three-phase generator step-up transformers 800/1,092 MVA/550 kV for the largest hydro power plant world-wide – delivered from our Nuremberg plant in Germany

Whispering in New York City

A three-phase autotransformer, 420 MVA/345 kV in extremely low-noise design. The optimization of the active part resulted in a 20 dB(A) reduction – delivered by our Weiz factory in Austria



Factoring solar winds in the Croatian solution for South Africa

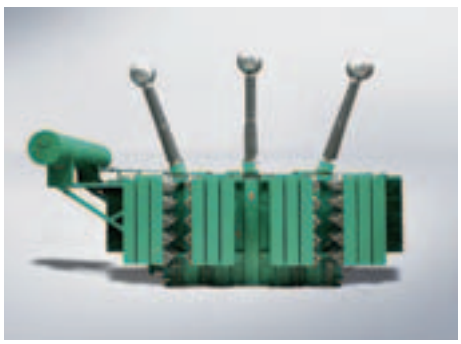
Four three-phase 450 MVA/420 kV generator step-up transformers in a special hot-spot design for the geomagnetic induced currents (GIC) – delivered by our Croatian factory in Zagreb

Geo-thermal power extension in China

Two three-phase 370 MVA/500 kV generator step-up transformers with extremely low no-load losses – delivered by our Chinese factory in Guangzhou for a geothermal power station in Henan province

Other 500 kV for China

Nine single-phase 250 MVA/525 kV autotransformers in low-loss design – delivered by our Chinese factory in Jinan for a power station in Shandong province



High domestic performance for Mexican Power

Three generator step-up transformers 420 MVA/375 kV have been delivered for two large hydroelectric power stations in the state of Coahuila in the north of Mexico from our domestic factory in Guanajuato

Brazilian excellence for the USA

Two three-phase autotransformers 800 MVA/345 kV, designed for simultaneous loading of HV, LV and tertiary according to ANSI/IEEE standards (C57.12.00) – delivered by our Brazilian factory in Jundiaí, São Paulo

Low losses for hot regions

A 320 MVA/245 kV three-phase network transformer for extremely high ambient temperatures in Abu Dhabi (+ 52 °C) – delivered with a special low-loss design by our Nuremberg factory in Germany

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